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Recent results on the antarctic meteorite ALHA 77003 which contribute to understanding the alteration processes which produced matrix in unequilibrated chondrites are presented. Also included are additional scanning electron microscope results confirming that the matrix in Allende formed by in situ alteration.

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ADDITIONAL EVIDENCE POINTING TO THE FORMATION OF ALLENDE MATRIX BY IN SITU ALTERATION. R. M. Housley, Rockwell International Science Center, Thousand Oaks, CA 91360.

"One of the important, and yet frequently violated ground rules of this game is that all facts, all interpretations, and especially all premises be critically reviewed from time to time." Anders, 1964, (2).

It has probably always been evident (1) that it is much easier to produce material resembling matrix in unequilibrated chondrites by parent body alteration processes than it is in any space environment.

The basic difficulty in producing matrix in the solar nebula comes from the long time it would take to form highly oxidized and hydrated silicates at the temperatures where they would become thermodynamically stable. This would require a long cool quiescent interval between the condensation of most of the material and the accreation of planetary bodies. It has also been known for more than 20 years (2,3) that this difficulty can easily be avoided by forming the matrix in parent bodies, where isolation from hydrogen permits oxidation at higher temperatures.

Despite all this it has seemed convenient until recently to regard the bulk of the matrix in unequilibrated meteorites as a primary constituent, since this appeared to provide a natural explanation for the systematic depletions in moderately volalite elements such as Zn which are observed when the other meteorite classes are compared to CI chondrites (2,4).

Serious difficulties with this hypothesis become evident though when one carefully considers the analyses of carbonaceous chondrite matrices reported by McSween and Richardson (5). They found substantial differences in matrix compositions from 100 μm spot to 100 μm spot within the same meteorite as well as in the average matrix compositions between different meteorites of the same class. Similar results for the ordinary chondrites were later reported by Huss et. al. (6). Analogous striking differences in matrix grain size and texture are also readily apparent.

These observations seem incompatible with the hypothesis of a single primative volatile rich matrix material. Each meteorite even within a given class would appear to require its own special matrix which would then have to be mixed in proper proportions with the other constituents to achieve the overall composition appropriate to the class. Such complications are completely circumvented if matrix resulted form parent body alteration.

We have previously reported (7) extensive scanning electron microscope evidence showing that much matrix olivine in Allende was produced by a reaction equivalent to $MgSiO_3 + Fe + \frac{1}{2} O_2 \rightarrow MgFeSi_2O_4$.

Following up a clue mentioned by Peck (8) we now present in Fig. 1 new evidence showing that much additional matrix olivine, as well as, Fe-rich clinopyroxene was produced by in situ alteration of a pre-existing Ca-rich mineral. The backscattered electron images of typical matrix regions compared to the Ca elemental maps of the corresponding regions seem to allow no other simple interpretation. The most probable Ca-rich precursor appears to be diopside. We have recently reported a strong tendency for diopside in the less altered meteorite ALHA 77003 to show alteration to Fe-rich olivine (9).

Besides providing additional evidence for matrix formation by alteration in Allende the current results provide strong evidence against post alteration regolith processes or impact mixing. They seem incompatible with any scenario which requires the formation of matrix as small grains in space (10).

(1) Urey (1961) JGR 66, 1988; (2) Anders (1964) Space Science Reviews 3, 583; (3) Wood (1963) Icarus 2, 152; (4) Wasson and Chou (1974) Meteoritics 9, 69;

(5) McSween and Richardson (1977) GCA 41, 1145; (6) Huss et. al. (1981) GCA 45, 33; (7) Housley and Cirlin (1983) Chondrules and their Origins. 145; (8) Peck (1983) Meteoritics 18, 373; (9) Housley (1984) Meteoritics 19, in press; (10) Kornacki and Wood (1984) GCA 48, 1963.

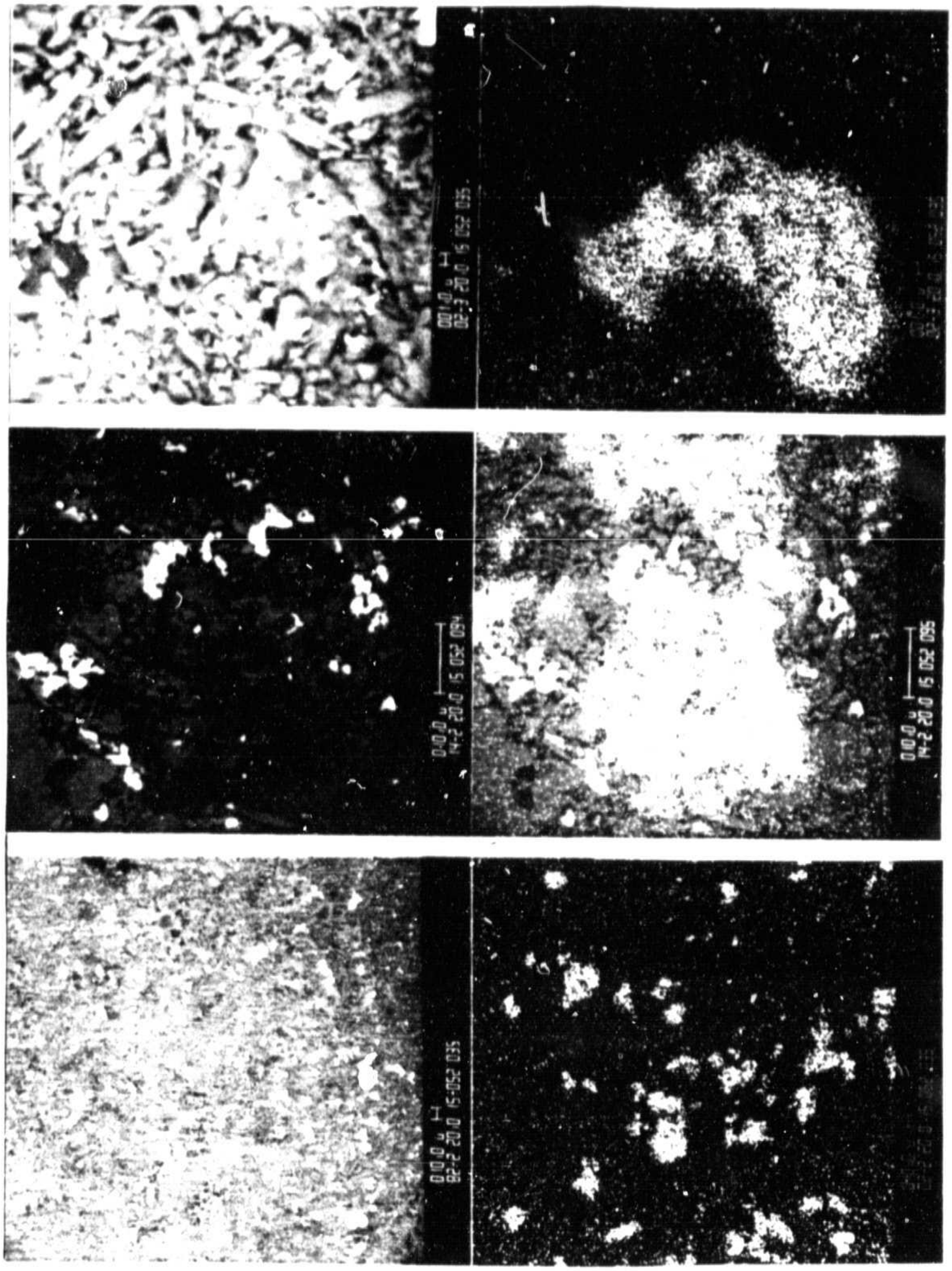

Fig. 1. Top: Backscattered electron images of typical Allende matrix at magnifications from 150 to 2250 as printed. Bottom Ca Kα maps of the corresponding areas above. BSE image is superposed in middle frame. Strong concentrations of Ca seem to be residues of altered grains.